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RESEARCH ARTICLE

Deficits in Radiation Health Affects Knowledge among Emergency Nurses in Japan's Nuclear Emergency Core Hospitals

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Abstract:

Background:

In the wake of the Fukushima Daiichi Nuclear Power Station disaster in 2011, Japan established Nuclear Emergency Core Hospitals (NECHs) to prepare for future nuclear incidents.

Objective:

This study investigates the knowledge and health anxiety related to radiation among nurses working in emergency units at NECHs in Kagoshima Prefecture.

Methods:

A web-based questionnaire was distributed to 36 nurses, utilizing a cross-sectional design with a response rate of 55.6%. The survey covered demographic details and posed questions about radiation health effects and nuclear disaster medicine.

Results:

Results revealed that only 30% had studied radiation health effects at educational institutions, and 95% expressed a desire for further training. The correct response rate for questions about nuclear disaster medicine was over 40%, but less than 10% for questions about radiation health effects.

Conclusion:

Despite limitations such as sample size and potential sampling bias, this study is the first of its kind. It highlights the urgent need for comprehensive training programs to improve nurses' knowledge and alleviate their health anxieties about radiation. Future research should extend this study to other regions and countries to validate these findings.

Keywords: Nuclear disaster, Radiological nursing, Radiation emergency medicine, Fukushima daiichi, Nuclear power station, The great east japan Earthquake, Nuclear emergency core hospital, Knowledge of radiation.

Article History

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1. INTRODUCTION

After the accident at the Fukushima Daiichi Nuclear Power Station following the Great East Japan Earthquake in March 2011 [1, 2], a nuclear emergency medical system was implemented in Japan [3]. The government took steps to prepare for nuclear disasters by establishing Nuclear Emergency Core Hospitals (NECHs) throughout Japan and making training in nuclear disaster medicine mandatory for all

personnel, notably those working in emergency units who would most likely be involved in nuclear disaster medicine [4]. NECHs are organizations that primarily receive casualties contaminated by radioactive materials during nuclear disasters and provide treatment for the injured. These facilities serve as specialized medical centers equipped to handle nuclear emergencies on the frontlines in Japan and are part of a global effort to enhance preparedness for nuclear incidents [5]. Hospitals like NECHs are not only crucial in Japan but also have counterparts in other countries, each with its own set of protocols and training programs. A recent study showed that only 31% of NECHs anticipated a radiation disaster,

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highlighting the importance of risk communications and planning for a radiation disaster in each region [6]. One study also revealed that over 80% of nurses in NECHs were concerned about proximity to nuclear power stations [7]; more than 50% of nurses in NECHs had incorrect knowledge about the health effects of radiation [7]. This lack of accurate knowledge can increase anxiety about treating contaminated patients and is particularly concerning, given that the health effects of radiation exposure can range from acute symptoms like nausea and vomiting to long-term consequences such as cancer and cardiovascular diseases [8]. Therefore, we investigated nurses working at emergency units in an NECH about health anxiety and knowledge regarding radiation.

2. MATERIALS and METHODS

2.1. Study Design

2.1.1. Cross-sectional Study

2.1.1.1. Setting

We sent research documents to the directors of nursing departments of NECHs in Kagoshima Prefecture. There are two NECHs in the area; one hospital has approximately 600 beds, while the other has about 250 beds. Furthermore, one hospital employs more than 700 nurses, and the other has a staff of over 200 nurses. The study was conducted in December 2022.

2.2. Participants

After obtaining the directors' consent, we asked them to report the number of nurses involved in nuclear disaster medicine, and we distributed a document with a QR code to access a Web-based questionnaire. The QR code was generated using a secure and anonymous web-based survey platform. Nurses scanned the QR code using their mobile devices, which redirected them to the questionnaire. Participation was voluntary, and all responses were anonymized to ensure confidentiality.

2.3. Variables

The questionnaire covered demographic details (gender, age, marital status, having young children, educational background, nursing position, employment location, department, training course attendance, post-employment qualifications, desire to belong to the content department, main nursing duties, whether they had learned about the health effects of radiation at an educational institution, whether they had been affected by the Fukushima nuclear power plant accident, whether they would like the opportunity to learn about radiation health effects, years of nursing experience, and years of experience in nuclear disaster medicine) and posed five questions about knowledge of radiation health effects and nuclear disaster medicine. The five questions regarding the

health effects of radiation and nuclear disaster medicine are as follows: "After a nuclear disaster occurs, what can you protect yourself from by wearing protective clothing like Tyvek suits? Please choose one from the options. (Options: 'All radiation exposure,' 'Contamination by radioactive materials,' 'Both contamination and exposure by radioactive materials,' 'Don't know'). The correct answer is 'contamination by radioactive materials,'" "In a study of second-generation A-bomb survivors (those whose parent or one of their parents was an A-bomb survivor and who were not in utero at the time of the bombings), what diseases or conditions were increased in those born to A-bomb survivors compared with those born to non-exposed survivors, and how were these increases possibly due to radiation? Please choose one from the options. (Options: 'Increase in cancer,' 'Increase in birth defects,' 'No reports of effects on second-generation A-bomb survivors,' 'Don't know'). The correct answer is 'No reports of effects on second-generation A-bomb survivors'" "If you are instructed to take stable iodine tablets in the event of a nuclear disaster, what type of radioactive material will protect you from internal exposure? Please choose one from the options. (Options: 'All radioactive materials,' 'Radioactive iodine,' 'Radioactive cesium,' 'Don't know'). The correct answer is 'radioactive iodine'" "Radioactive material was found on the healthy skin of your right forearm with a cumulative exposure of 30 mSv. What are your concerns about the possible effects of this situation? Please choose one from the options. (Options: 'Skin redness,' 'Skin burns,' 'No particular effects,' 'Don't know'). The correct answer is 'no particular effects'" "What are the possible effects of exposing a woman's abdomen to 100 mSv of radiation at one time? Please choose one from the options. (Options: 'Temporary infertility,' 'Genetic effects on future children or grandchildren,' 'No particular effects,' 'Don't know'). The correct answer is 'no particular effects'."

2.4. Ethical Consideration

This study was approved by the Ethics Committee of the Kagoshima University Epidemiological Study (approval number 210291).

3. RESULTS

We identified 36 nurses who expected to be involved in nuclear disaster medicine and obtained responses from 20 (55.6%). Descriptive statistics of the demographic factors of the study participants appear in Table 1. Among the participants, 30% had studied radiation health effects at their educational institutions, 55% had undergone a training course about nuclear disaster medicine, and 95% wished to learn more about it. The questionnaire results about knowledge of radiation health effects and nuclear disaster medicine appear in Table 2. The correct response rate among our participants with questions about nuclear disaster medicine was over 40%; however, the correct response rate for questions about radiation health effects was less than 10%.

Table 1. Descriptive statistics of participant demographic factors.

Variables	-	n	%	Median	IQR
Gender	Male	3	15	-	-
-	Female	17	85	-	-

(Table 1) contd....

Variables	-	n	%	Median	IQR
Age	20s	5	25	-	-
-	30s	4	20	-	-
-	40s	6	30	-	-
-	50s	5	25	-	-
Spouse	Yes	11	55	-	-
-	No	9	45	-	-
Having young children	Yes	6	30	-	-
-	No	14	70	-	-
Educational background	Nursing high school	1	5	-	-
-	Professional training college	10	50	-	-
-	Junior college	3	15	-	-
-	University or college	5	25	-	-
-	Master's course	1	5	-	-
Nursing position	Staff	17	85	-	-
-	Senior staff	1	5	-	-
-	Assistant chief nurse	2	10	-	-
Employment location	Within Urgent Protective action planning Zone (UPZ)	7	35	-	-
-	Outside UPZ	11	55	-	-
-	Unknown	2	10	-	-
Department	Outpatient ward	4	20	-	-
-	Emergency unit	12	60	-	-
-	Nursing department	2	10	-	-
-	Radiology department	1	5	-	-
-	Urology department	1	5	-	-
Nuclear disaster medicine training course attendance	Yes	11	55	-	-
-	No	9	45	-	-
Post-employment qualifications	Yes	5	25	-	-
-	No	15	75	-	-
Desire to belong to the content department	Yes	15	75	-	-
-	No	5	25	-	-
Main nursing duties	Diagnostic imaging assistance	3	15	-	-
-	Interventional radiology	8	40	-	-
-	Endoscopy and fluoroscopy	8	40	-	-
-	Nuclear medicine examination assistance	0	0	-	-
-	Radiotherapy	0	5	-	-
-	Hospital ward	4	20	-	-
-	Outpatient	4	20	-	-
-	Emergency	1	55	-	-
-	General nursing operation	2	10	-	-
Learned about radiation health effects at an educational institution.	Yes	6	30	-	-
-	No	14	70	-	-
Affected by Fukushima nuclear power plant accident	Yes	0	0	-	-
-	No	20	100	-	-
Desire to participate in an opportunity to learn about radiation health effects	Yes	19	95	-	-
-	No	1	5	-	-
Nursing experience	years	-	-	0.5	[8–24.5]
Years of experience in nuclear disaster medicine	years	-	-	0	[0–2.5]

Abbreviation: IQR: Interquartile range.

Table 2. Questions about knowledge of radiation health effects.

Questions	Correct Answer Rate
After a nuclear disaster occurs, what can you protect yourself from by wearing protective clothing like Tyvek suits? Please choose one from the options.	50%
In a study of second-generation A-bomb survivors (those whose parent or one of their parents was an A-bomb survivor and who were not in utero at the time of the bombings), what diseases or conditions were increased in those born to A-bomb survivors compared with those born to non-exposed survivors, and how were these increases possibly due to radiation? Please choose one from the options.	10%
If you are instructed to take stable iodine tablets in the event of a nuclear disaster, what type of radioactive material will protect you from internal exposure? Please choose one from the options.	40%
Radioactive material was found on the healthy skin of your right forearm with a cumulative exposure of 30 mSv. What are your concerns about the possible effects of this situation? Please choose one from the options.	5%
What are the possible effects of exposing a woman's abdomen to 100 mSv of radiation at one time? Please choose one from the options.	10%

4. DISCUSSION

For many years, the nursing curriculum in Japan has included little or no content about radiation, and many nurses conduct their work without understanding the related health effects [9, 10]. However, following the Fukushima accident and our study results, we believe that nurses residents in prefectures with nuclear power plants are eager to learn about radiation health effects. In contrast, other countries have taken different approaches to hospital preparedness for nuclear disasters. For instance, a study from Iran evaluated the preparedness of hospital emergency departments for various types of disasters, including nuclear ones, emphasizing the importance of staff training and planning [11]. Another study from Australia discussed the capacity of hospitals to respond to Chemical, Biological, Radiological, and Nuclear (CBRN) disasters, highlighting the role of specialized training programs [12]. These international perspectives underscore the need for comprehensive training that includes not only disaster-specific protocols but also basic education on radiation and its health effects. In our study, half of our participants had undergone training in nuclear disaster medicine; however, most wished to learn more about radiation health effects, suggesting a lack of instruction in that regard. Nurses who may need to be involved in nuclear disaster medicine have to attend the Nuclear Regulation Authority's Nuclear Disaster Medical Core Personnel Training Program [5]. However, with that program, most of the time is devoted to acquiring knowledge and skills related to nuclear disaster medicine. There is insufficient opportunity for lectures on radiation basics and health effects. It has also been suggested that many nurses may be unfamiliar with radiation health effects, which are far removed from daily nursing practice.

CONCLUSION

The present study has several limitations. First, this study examined only nurses who might become engaged with nuclear disaster medicine at NECHs in Kagoshima Prefecture; thus, there is a possibility of sampling bias. Second, the sample size is extremely limited. Third, the results may not be generalizable to all nurses working at NECHs, as those involved in nuclear disaster medicine often work in the emergency department.

Despite these limitations, this is the first investigation into nurses at NECHs who may engage in nuclear disaster medicine, making it a valuable contribution to future measures in this field. We observed that nurses working in NECHs are likely to have limited knowledge of the health effects of radiation and a strong desire for further training. Ongoing training is essential to alleviate their concerns. Future research should extend this survey to nurses in other prefectures and countries to validate these findings and explore the impact of training on reducing radiation health concerns.

ABBREVIATIONS

CBRN = Chemical, Biological, Radiological, and Nuclear

NECHs = Nuclear Emergency Core Hospitals

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee of the Kagoshima University Epidemiological Study (approval number 210291).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data of current study are available from author, [T.Y], on a reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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